Meet Colorado State University Soil Microbiologist

Dr. Mary Stromberger

I work CSU College of Agricultural Sciences in the Department of Soil and Crop Sciences. My research goal is to increase our understanding of soil microbial communities and their activities, so that we can use them to our benefit. Bacteria can be harmful like *Escherichia coli*, commonly called *E. coli*, which can give you food poisoning. Other bacteria are beneficial, like rhizobacteria that help the roots of plants acquire needed nitrogen for healthy growth. Specifically, I am interested in identifying important ecosystem service providers (components in an ecosystem to provide human benefits) within microbial communities, the **abiotic** and **biotic** factors that control their activities, and **spatial** and **temporal** scales over which these microbes and their activities occur.

Recently, I have studied bacteria involved in pesticide **degradation** as well as root-colonizing bacteria that may enhance drought tolerance of winter wheat. Atrazine is an herbicide used to prevent broadleaf weeds from growing in corn and other crops or on turf on golf courses and residential lawns. In one study, I examined the spatial pattern of atrazine-**degrading** bacteria in northeastern Colorado and determined the **factors** that predict for **accelerated** atrazine **degradation** in soil. Right now, I am studying a group of bacteria that colonize the roots of winter wheat. Under drought stress, these bacteria can promote enhanced drought tolerance of the wheat, but I've found that this is dependent on the specific wheat cultivar. I have also studied how earthworms and their burrows affect microbial communities and water properties of soil.

What you see is that the most outstanding feature of life's history is a constant domination by bacteria.

Elliot Gould

STEM Connections

Colorado State University Extension

Connecting Science, Technology, Engineering, and Math concepts to our everyday lives.

The Dirt on Dirt! (Part 2)

Beneficial soil microbial communities (for example bacteria) can help our plants to thrive

http://departments.agri.huji.ac.il/plantpath/jurkevitch/img/rbe-bg.jpg

Microbes are organisms too small to see with our naked eye. They include bacteria and archaea (like bacteria, but their DNA is different), some fungi (mushrooms, and mold), and some protists (tiny multi-cellular creatures like foraminifera). To see them, you need a microscope.

Some microbes cause disease in plants and animals, while other microbes are beneficial. They are everywhere, including our skin and gut (beneficial gut flora help to digest food), on and in plants, in the water and soil. You may have examined pond water microbes in your school, and these microbes also exist in soil. Last month, we talked about humus, organic matter that has **degraded**, and provides the nutrients that plants need. This is where soil microbes thrive. We are going to examine these organisms by growing them until their colonies are large enough to see.

EXPLORE IT - DESIGN IT - DO IT

- With the sharpie, write the date on each ziplock baggie carefully so as to not to damage the gelatin in the foil liner.
- You will collect soil samples from 6 different locations, and each baggie needs to be labeled with that location. It is important not to mix up your samples, so label the baggie, collect the sample, and **inoculate** your gelatin before starting on the next sample.
- Do you think more microbes grow on top of the soil or two feet down? Write "top of hole" on your first baggie, and collect a bit of dirt into your paper cup. Add about twice as much water as soil to make a slurry. Open that baggie (do not remove your gelatin). Dip your first cotton swab into the water and gently rub the swab on top of the gelatin (gently so it doesn't tear the gelatin). **Zip the baggie closed** and set aside. Dispose of the paper cup and cotton swab.
- Write "bottom of hole" on your next baggie. Dig a hole 2 feet deep and collect a bit of dirt from the bottom of the hole into a clean paper cup. Add about twice as much water as soil to make a slurry. Open that baggie (do not remove your gelatin). Dip a clean cotton swab into the water and gently rub the swab on top of the gelatin. **Zip the baggie** closed and set aside. Dispose of the paper cup and cotton swab.
- Write "garden" on your next baggie. Collect a bit of dirt from a garden into a clean paper cup. Add about twice as much water as soil to make a slurry. Open that baggie. Dip a clean cotton swab into the water and gently rub the swab on top of the gelatin. **Zip the baggie closed** and set aside. Dispose of the paper cup and cotton swab.
- Write "compost pile" on your next baggie. Collect a bit of dirt from the bottom of the compost pile into a clean paper cup. Add about twice as much water as soil to make a slurry. Open that baggie. Dip a clean cotton swab into the water and gently rub the swab on top of the gelatin. **Zip the baggie closed** and set aside. Dispose of the paper cup and cotton swab.
- Pick two more sites, like by the street, a gravel pit, etc. Label the baggie, collect the sample and mix with water, **inoculate** your gelatin, **zip the baggie closed,** set aside, and dispose of the cup and cotton swab.
- When you have collected all 6 samples, lay them out on a table and examine them. Which sample do you think has the most microbes? Which has the least? Write down your guesses and why. **DO NOT OPEN THE BAGGIES**.
- **DO NOT OPEN THE BAGGIES**. While the microbes you collect are probably beneficial, you may be growing harmful microbes also.
- Store the baggies for 1 week in a dark, warm place (like under the kitchen sink). **DO NOT OPEN THE BAGGIES**.
- After one week, (**DO NOT OPEN THE BAGGIES**) examine your 6 samples and compare to your guesses. Were your guesses right? If you were wrong, can you figure out why?

Age Appropriate:
4th—HS grades

Time Required:
2 hours total over 1 week

Materials:
- 1 pkg. plain gelatin
- 1 c water
- 2 tsp. sugar
- 1 beef bouillon cube
- 6 foil muffin/cupcake liners
- muffin pan
- 6 ziplock sandwich bags
- measure cup, teaspoon, saucepan, wooden spoon
- 1 sharpie marker
- 6 paper cups
- 6 cotton swabs
- shovel

The Set-up:
- Place 6 foil muffin/cupcake liners in the muffin pan.
- In a saucepan, mix gelatin, water, sugar, and bouillon, slowly bringing to a boil, stirring constantly with the wooden spoon.
- Cool slightly.
- Pour the gelatin solution into the 6 foil liners about 1" deep. You won't use all the gelatin.
- Cool in refrigerator until gelatin is solid.
- DO **NOT** TOUCH GELATIN!!!
- Remove the gelatin in the foil liners from the muffin pan, and store each individually in a ziplock sandwich bag.

The Clean-up:
- Wash dishes, put away equipment, and dispose of paper cups and cotton swabs
- Keep the baggies zipped closed and dispose in trash.

Power Words
- **abiotic**: the non-living part of an ecosystem, like water or rocks
- **accelerate**: change in speed; increase in speed
- **biotic**: the living part of an ecosystem, like plants and bacteria
- **degradation/degrade**: chemical process of breaking down
- **factor**: something that contributes to a result or outcome
- **inoculate**: placement of something that will grow
- **spatial**: relating to space
- **temporal**: relating to time